

# ILC Detector R& D Needs at Fermilab

Talk to Comp. Division on Feb 25, 2005

*On behalf of ILC detector R& D groups*

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## International Linear Collider

### Machine

Dominates picture after  
technology decision  
BIG effort  
GDI formation is next step  
Main parts(Working Groups):

Overall Design  
Injector  
Main Linac  
Beam Delivery  
Cavities  
Communications & Outreach

CDR in about 1 year

Site preparation ( for FNAL)

Talk by S.Mishra on needs last Tuesday

### Detectors

Driven by physics  
requirements  
Adopt to machine  
parameters

Much smaller effort  
( no R&D Funds in past in US)  
Final size ~10-15% of total  
budget

CDR needed as part of machine  
CDR

Strong  
link

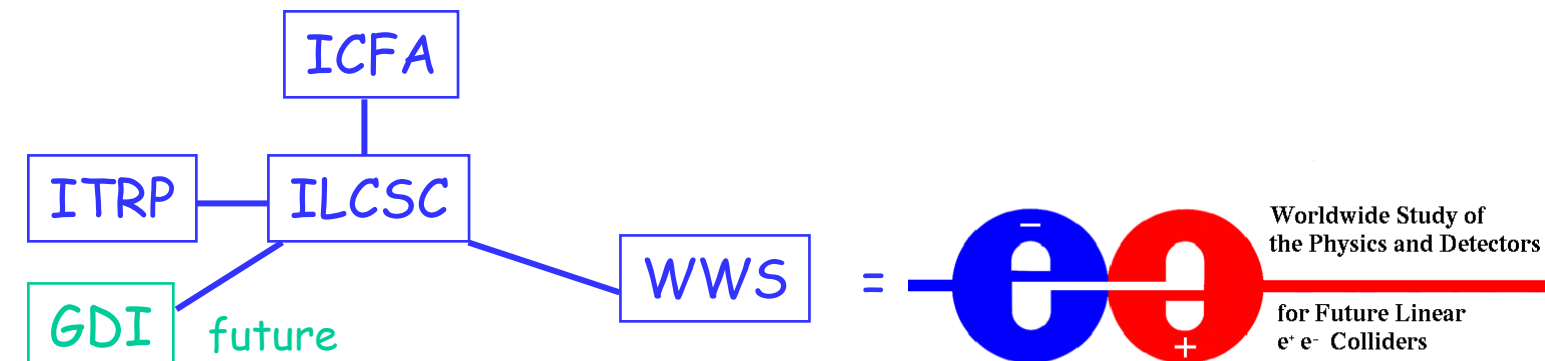


to the normal approach to new experiments at Fermilab or any lab

Historically: Local efforts starts, idea, develop design, flesh out, build, etc.  
Users may come from all over the globe ( CDF, Dzero)  
Detector components even build all around the globe ( some in CDF, Dzero but really in CMS & ATLAS).....still local approach to detectors

ILC detectors: Very different....  
Global approach from start, includes whole globe, no laboratory defined yet as home, but all institutions involved  
Does not make it easier, but is necessary

It is like comparing the United Nations ( *action slow*) to national governments ( *action can be fast*)



Physics & Detectors

Makes physics case

Detector development; up to now mainly  
"generic" detector R&D

R& D activities: Silicon (SiLC)  
TPC/Jet chambers  
Vertex detectors  
Calorimetry (CALICE) (EM & HAD)  
Muon System -- at FNAL

There was a TESLA  
detector design

..... Well funded in EU and Asia  
Not well funded in US

This was situation up to Spring 2004

In February 2004 ILCSC asked WWS to develop a plan for detectors corresponding to machine schedule/plan

## Machine schedule/plan

- 2004 International technology selection.  
Initiate the Global Design Effort.
- 2005 Complete the accelerator **CDR**,  
including site requirements, and  
initial cost and schedule plan.
- 2006 Initiate detailed engineering designs  
under the leadership of the  
CentralTeam.
- 2007 A complete detailed accelerator TDR  
with the cost and schedule  
plan, establish the roles &  
responsibilities of regions, and begin  
the process for site proposals.
- 2008 Site selection and approval of  
international roles & responsibilities  
by the governments.

.....  
2009 Start construction  
2015 Start operation

## WWS plan/answer:

- 2005 Preliminary costing of at least two whole detector concepts** (single joint document with performance estimates for each concept, plus R&D done and still required.) Produce in time to be included in the Accelerator CDR process of the GDI.
- 2007 Detector CDRs** –Conceptual Design Reports for experiments (could be different from concepts above) with specification of physics performance on key benchmarks, technical feasibility, and refined cost. Individuals encouraged to sign more than one CDR.
- 2008 Proposals** – Groups united around CDR detector concepts submit Letters of Intent for proposals (including performance, costs, and technical feasibility) to the Global Lab, which will invite some of the groups to produce TDRs.

Consequences of this WWS detector plan:

- Start design studies for a limited number of detector concepts

- Evolve to some kind of "CDR" with physics benchmark performance and cost estimate.

- All design concept studies should be global i.e. participation from all regions of globe

- Individuals/groups can participate in more than one concept

Start "proto" collaborations of people interested in a concept

Happened at series of WWS workshops:

Americas  
Victoria, BC  
August '04

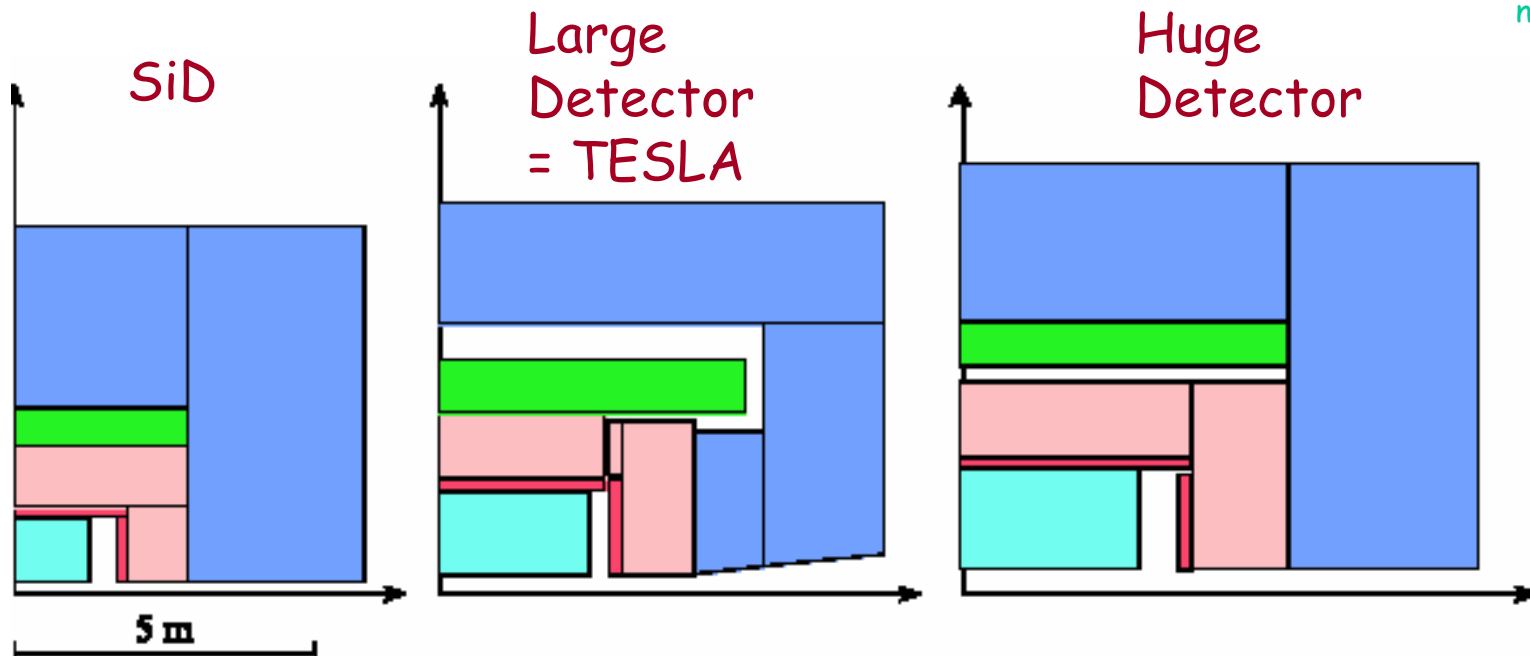
Europe  
Durham, UK  
Sept '04

Asia  
Taipei, Taiwan  
Nov '04

For the moment three concepts have emerged ( final meeting in Taiwan) and have been launched.

Innovative names

All detectors are BIG



All Si tracking; smaller; hopefully cheaper with same performance.  
Centered in US ( **SLAC & FNAL + Users**)  
Leadership at FNAL& SLAC (Jaros/Weerts).  
Had mtgs at Victoria, Durham & Taipei

TPC based tracking + Si tracking  
Centered in EU + some US  
Forming  
Based on TESLA work = advantage

Similar to Large version, but Bigger.  
Driven Asian interests mainly.  
Official launched in Taipei

All global, but not easy.....

## Activities already (SiD focus)

Si tracker layout & design

HCAL electronics  
Testbeam setup

Solenoid feasibility

Muon detector R&D; muon system  
& algorithm development

Electronics development (  
ASICs, readout)

## Possible future activities

Tracking simulations ( Kansas  
already)

HCAL detector development &  
simulation; testbeam

Solenoid design

Continue & strengthen

Expand into other areas

DAQ and "trigger"

Simulation



Wish that we could give a complete and detailed list of items to work on, however situation not that clear

Will try and give you some specific areas where help is needed and CD specific  
Not an exhaustive or definitive list

Consider this really as starting point of a dialogue and exchange. As things become more clear hope to reiterate

**WANT:** Important/leading role of Fermilab in Si tracker for SiD or any other tracker

Build on available expertise at SiDet

Want Fermilab to play a leading role in tracker. Interest in SLAC and Fermilab being complementary.

Willingness of SiDet to do this

**NEED:** Physicist(s) to help with and/or spearhead simulation

This is currently a "chicken and egg" problem i.e. need some help to get more effort into this from SiDet

Specifically M. Demarteau would be willing to lead Si tracking effort in SiD if he had some help on simulation front

Already help on design effort  
from PPD: engineering & physicists



# Muon algorithm development

H.Weerts

C. Milstene & H.E.Fisk working on muon system and pattern recognition and tracking algorithm for muons (thru all detectors).

This is a Fermilab & collaborators (Notre Dame, Wayne State, Indiana) generic R&D effort in hardware development/testing as well as algorithm development.

Algorithm development could use help

**NOTE:** The following slides describe activities that we can see the CD becoming involved in, but it really needs people from CD to become familiar with ILC detector field to see what directions to be pursued by CD

Install & maintain the SLAC based generic detector simulation/analysis system at Fermilab. This is JAVA based system which is "Global" does not make this easy widely used in US, but not outside

Collaboration with SLAC on development, with eye towards coherence & complementarity for development of computing tools for ILC detector simulation & analysis

Develop a direction for CD for coming years that fits needs at Fermilab and contributes to the global ILC efforts.

DAQ systems for ILC detectors; far away in time

Substantial testbeam effort at Fermilab 2005-2008; large amount of data; impact unclear for now. Should explore.



## Involvement of CD II

H.Weerts

Some  
examples:

1. Collaboration with group at NIU, because of expertise & closeness ( involved in both the overall detector simulation and the calorimeter testbeam simulation). Experts on LCGD4( SLAC,NIU) & Mokka ( Europe).
2. Linear Collider note system..... not existent now.
3. Geometry interface system for simulation, calibration and analysis
4. Detector response simulation/ digitization ( NIU start)
5. Data Model & Persistency: LCIO provides the data model, SIO provides the current persistency. Upgrade the persistency mechanism without modifying the event data model.
6. LCD would like to use advertised GRID benefits. Are there any aspects of FNAL distributed computing which could be applied to LCD?
7. Bookkeeping and access to MC data, stored at SLAC MSTORE system, access through FORTRAN interface and only SLAC Linux. Improve.



There are more possibilities, but strongly feel that a small group from CD ( with our help) should become familiar with ILC detector R&D in general and specifically simulation, and develop a plan for the near and far future.

This implies active involvement and a first step would be to attend LCWS05 and the Simulation Workshop preceding it on March 16, 17 at SLAC.

- Tracking simulation efforts in SiD, define tracking system in SiD; complementary to SiDet efforts  
Ramp up before ALCPG 2005 at Snowmass
- Effort on muon tracking algorithm, work with Fisk/Milstene
- Install & Maintain current SLAC based simulation/analysis tools for SiD at FNAL
- One or two people to monitor efforts on computing ILC front and propose directions where FNAL CD can contribute  
Attend LCWS05 & Sim. Wrkshop
- Testbeam efforts, not clear what will be request yet